DOE/NV/25946-1637

Lessons Re-Learned

The little things!

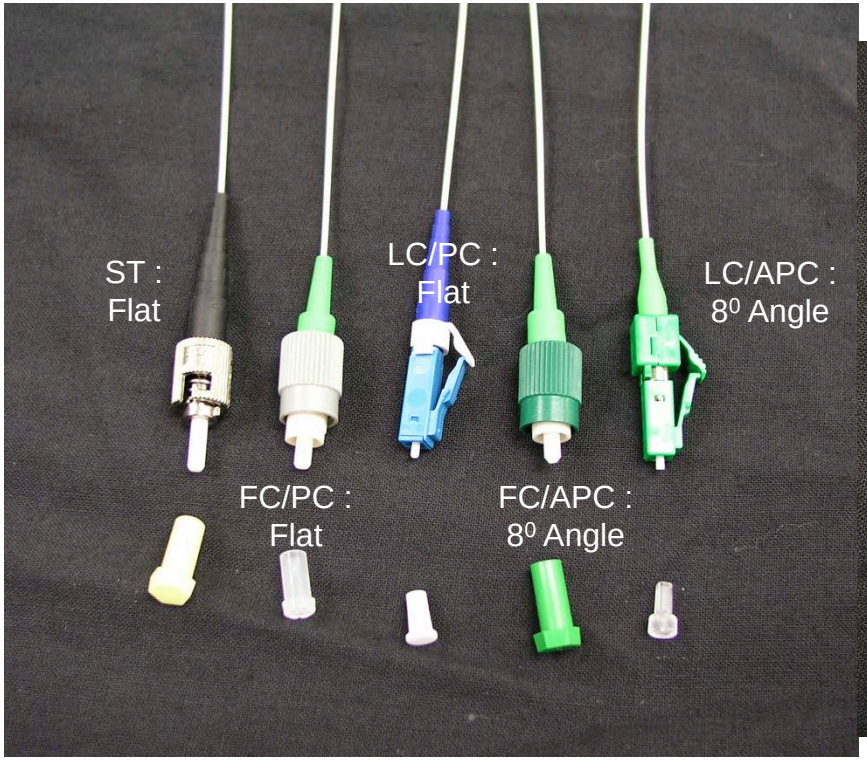
Carlos Perez Jr. and Tyler Lewis

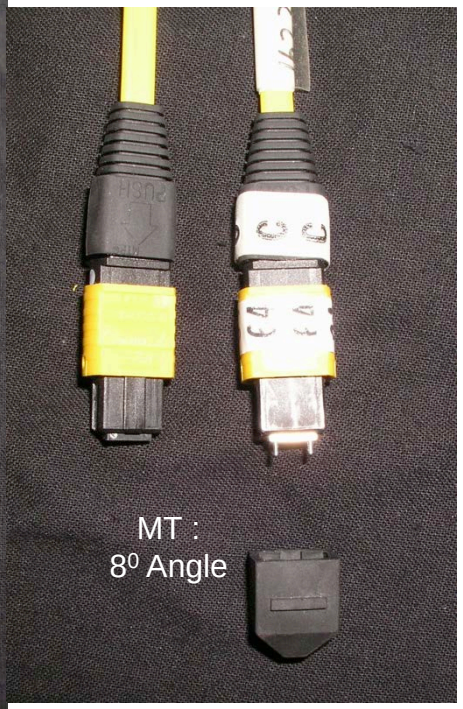
This work was done by
National Security Technologies, LLC,
Under Contract No. DE-AC52-06NA25946
with the U.S. Department of Energy

Topics

- Connector Choices
- Polishing Technique
  - Manual vs. Machine Polish
- Fiber Interconnect Construction
  - Vendor termination technique
- Deployment of fiber in the field

Connector Choices





Polish Techniques

- Manual vs. Machine Polish

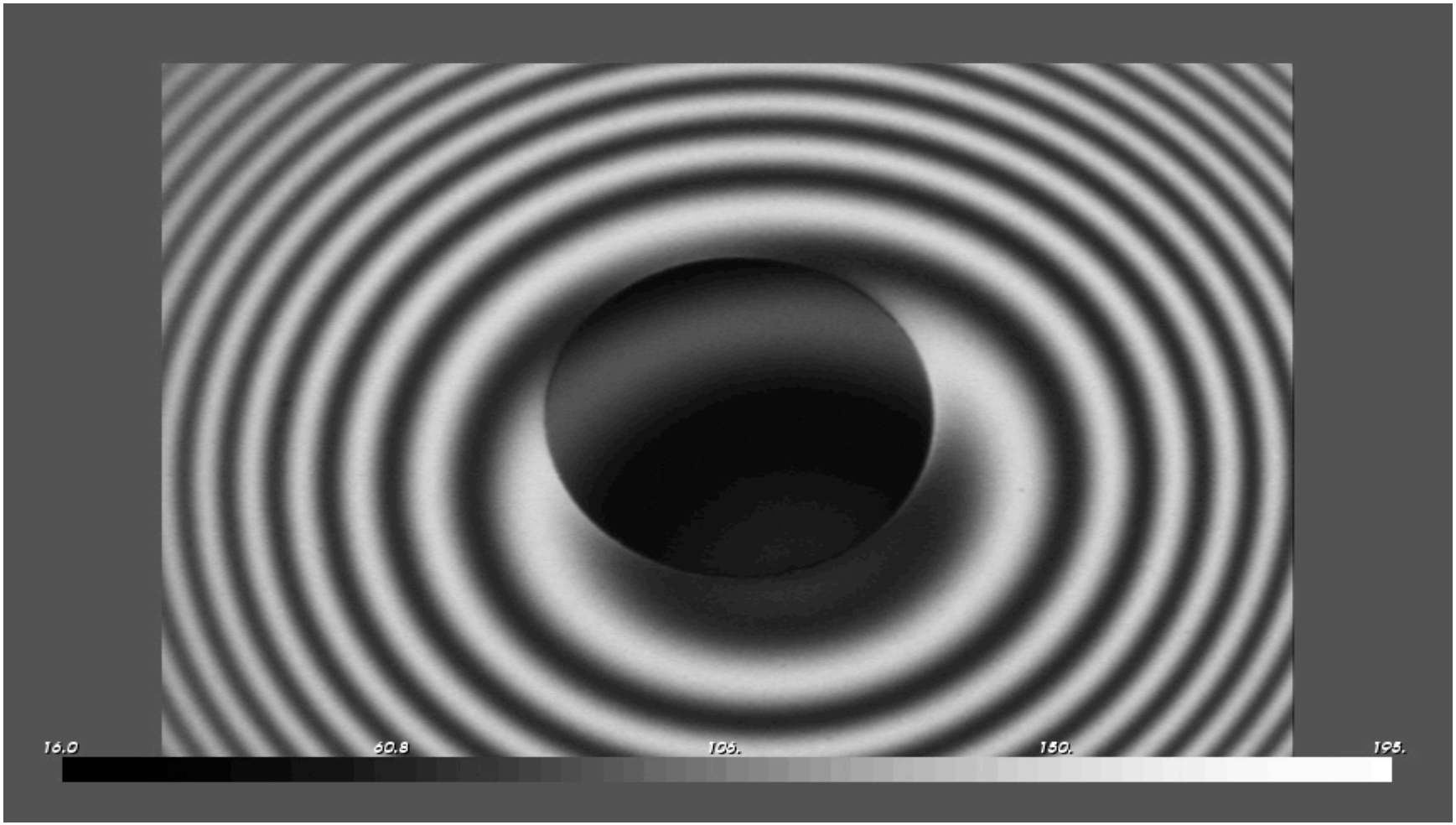
  ST, FC/PC, FC/APC, LC/PC, LC/APC & MT/APC Connectors

  Measurable Metrics
  - Repeatability,
  - Loss,
  - Back Reflections,
  - Curvature,
  - Fiber Height,
  - Linear Apex Offset,
  - Ferrule Angle
- Time

Manual Polish Interferogram

LC/PC Fiber Center vs APEX

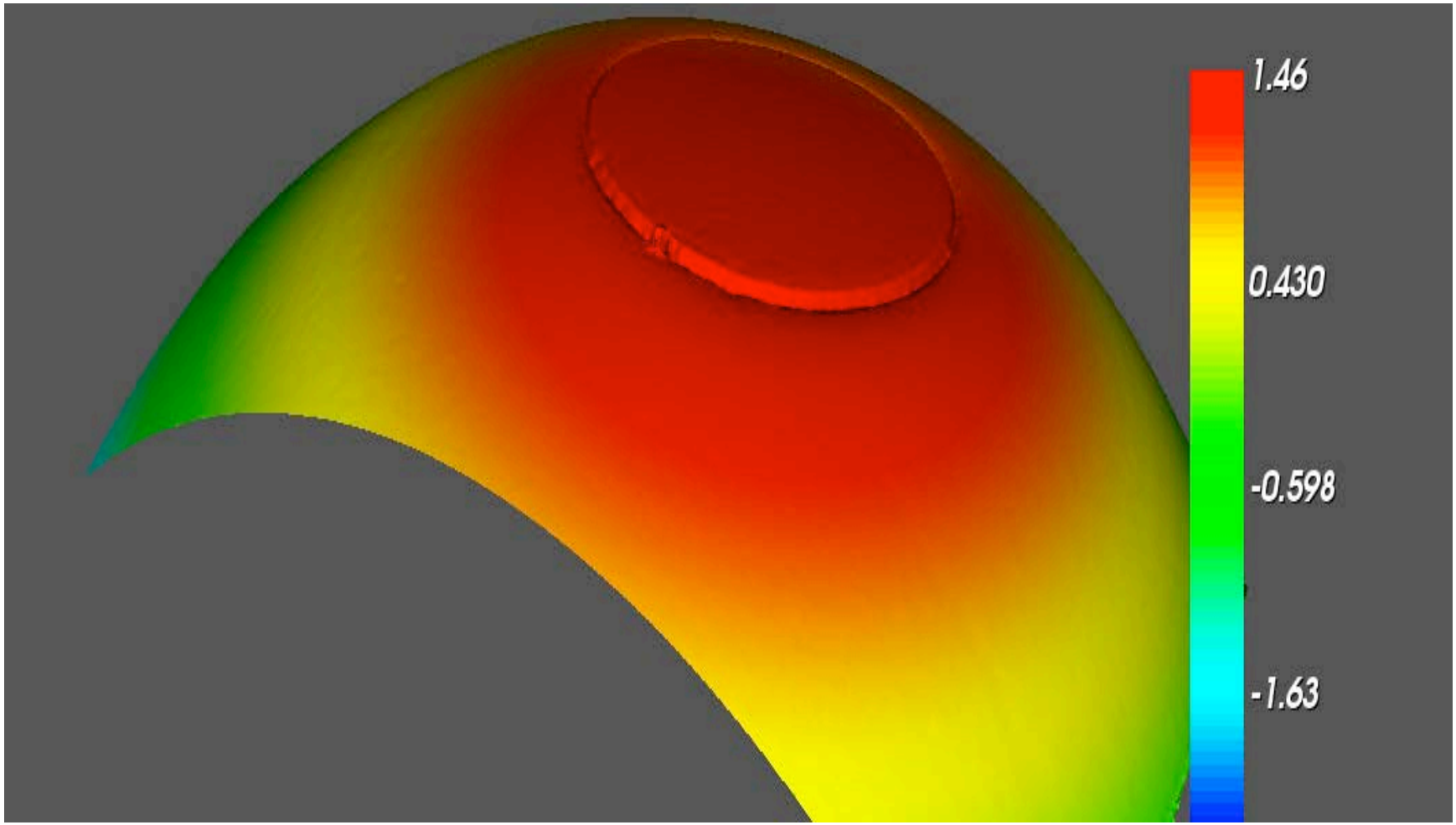
Note : This is after multiple connections and cleaning before each connection.



Manual Polish Topography

LC/PC Fiber Center vs APEX

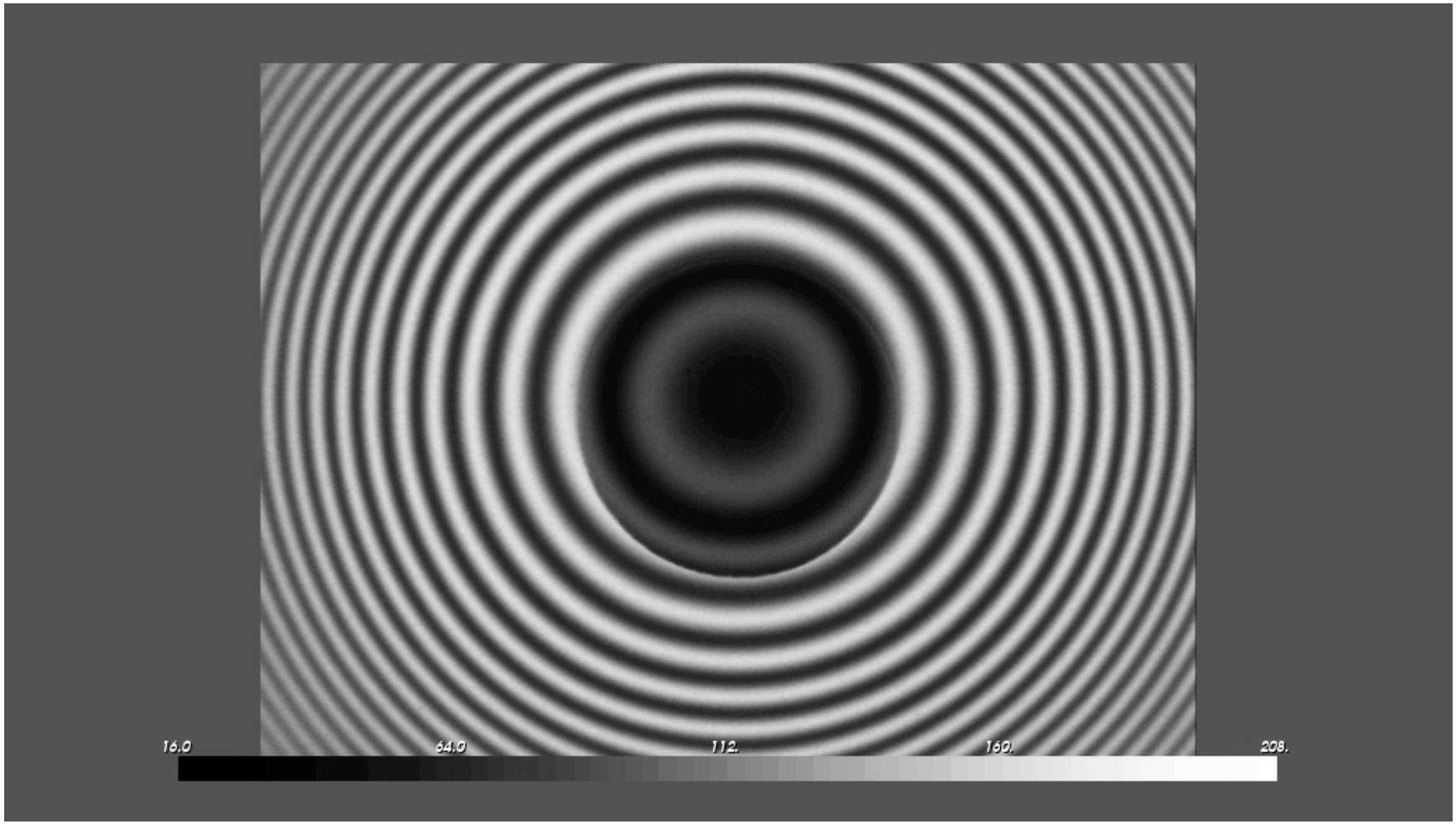
Note : This is after multiple connections and cleaning before each connection.



Machine Polish Interferogram

LC/PC Fiber Center vs APEX

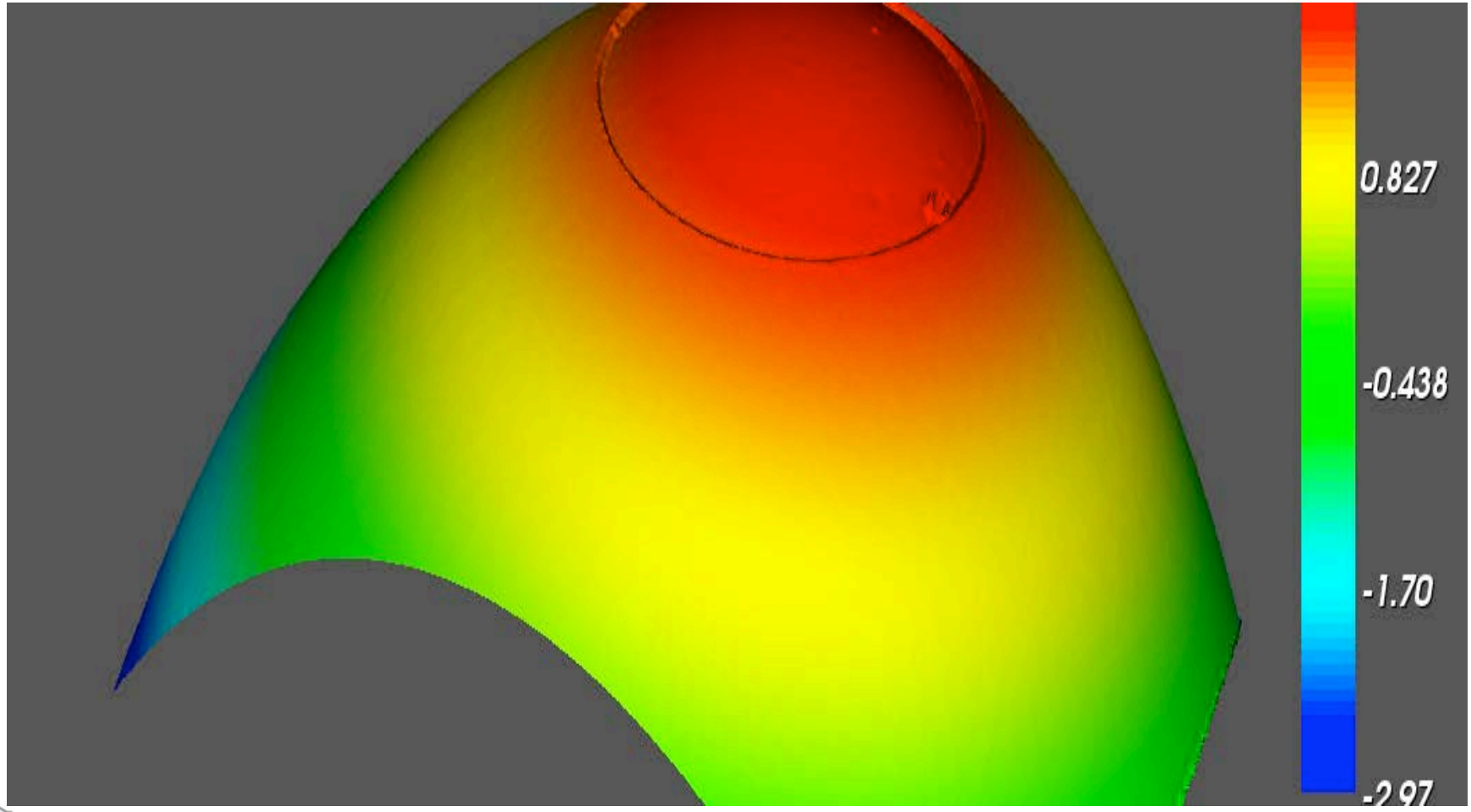
Note : This is after multiple connections and cleaning before each connection.



Machine Polish Topography

LC/PC Fiber Center vs APEX

Note : This is after multiple connections and cleaning before each connection. Damage is being seen with repeated connections. This did not come off with standard alcohol wipes and lint free wipes.



Polishing Technique Statistical Study

- Sample size 6.
- Machine Polish reduced loss on average by
  ST : 0.1dB,
  FC : 0.3dB, FC/APC : 0.2dB,
  LC : 0.2dB, LC/APC : 0.3dB
- Machine Polish improved B.R.

  FC/APC by 13 dB and
  LC/APC by 2.5 dB*
- In the two connectors with an 8 degree polish

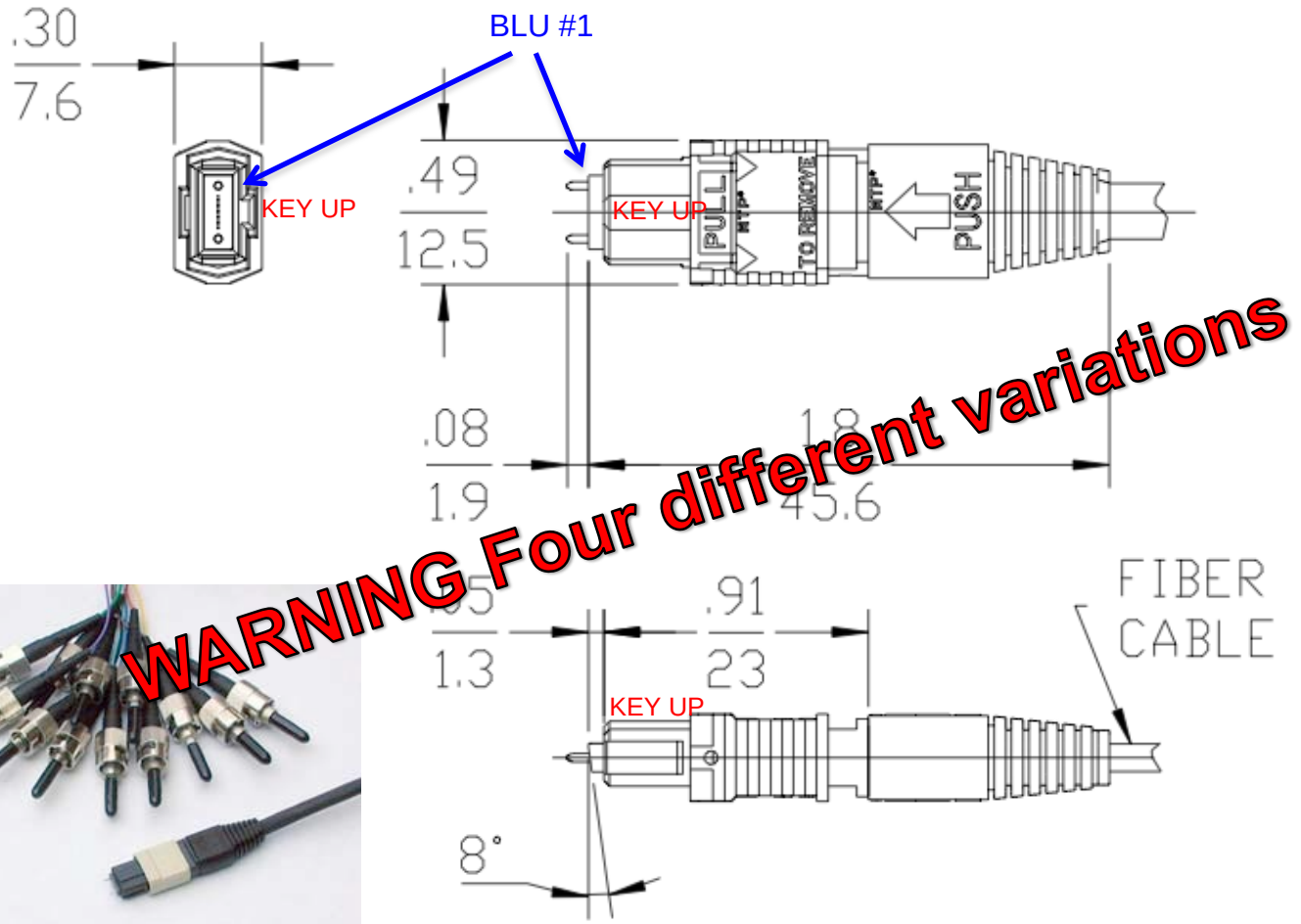
  FC/APC manual (7 to 7.7 degree) vs FC/APC machine (7 degree)
  LC/APC manual (8.6 to 8.7 degree) vs LC/APC machine (7 to 7.9 degree)*

  Note : Pay close attention to the Disc purchased for the Machine Polish. There are three different angles as an option from Domaille.
- Connector termination time.

  While the time to epoxy connectors is no different, polishing time was improved significantly. Manually 15 minutes for one connector vs. Machine 15 minutes for twelve connectors.

** Topic of further investigations.*

MT Standard Configuration



WARNING Four different variations

TYPE A
#1 BLU
#2 ORG
#3 GRN
#4 BRN
#5 SLT
#6 WHT
#7 RED
#8 BLK
#9 YLW
#10 VIO
#11 ROS
#12 AQU

Note : The order of the color code is established by ANSI/TIA/EIA 598-A.

Fiber Interconnect Construction

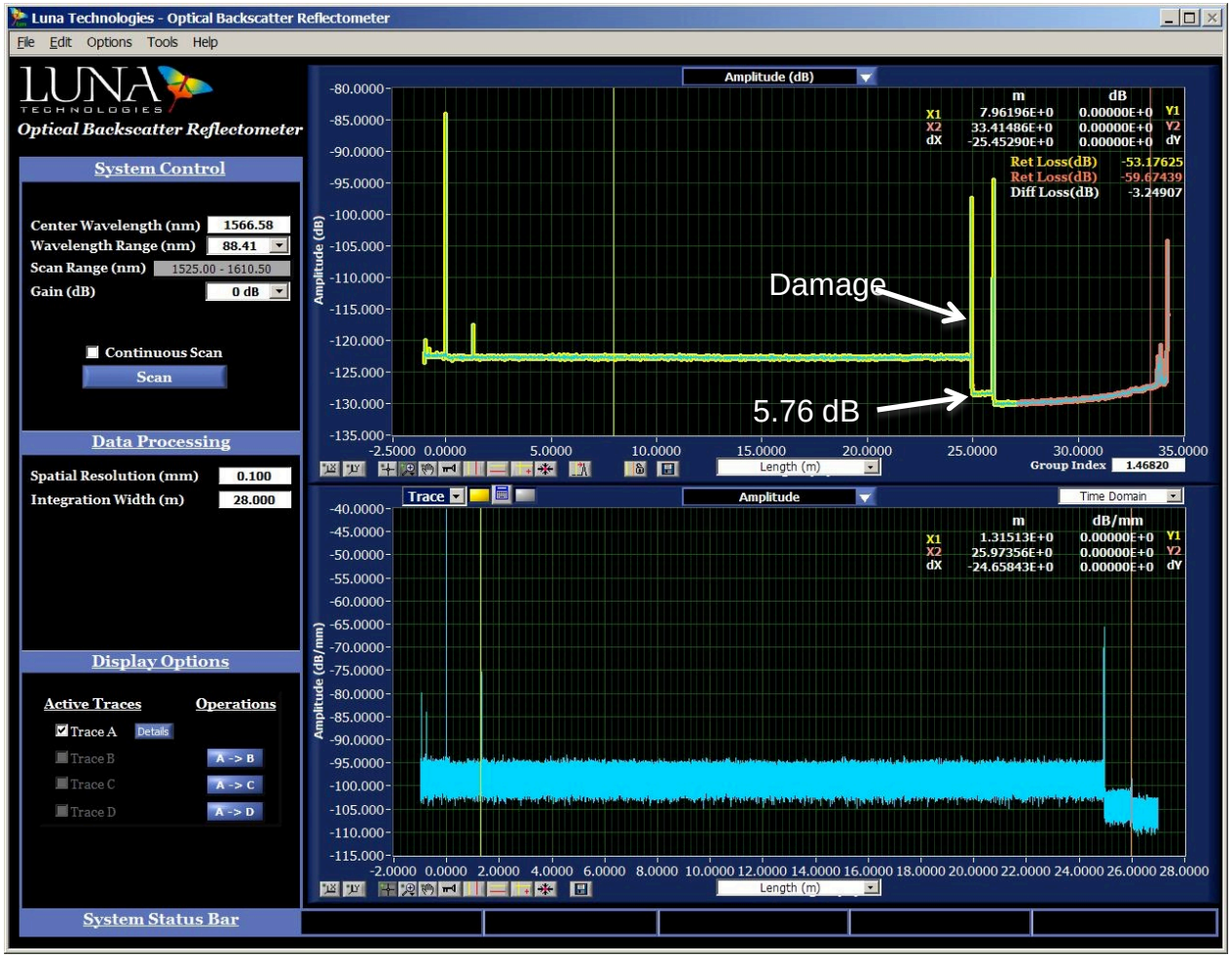
- Vendor construction techniques
  - Jacket
  - Break out
  - Strain relief
  - Epoxy in connector back shell (Spray / Syringe)
    - Spray : Resin & Catalyst
    - Syringe : fills back without voids

Have Been Bitten By

24.6 m Main Line Breakout & Strain Relief Issues

(6-2 ORG)

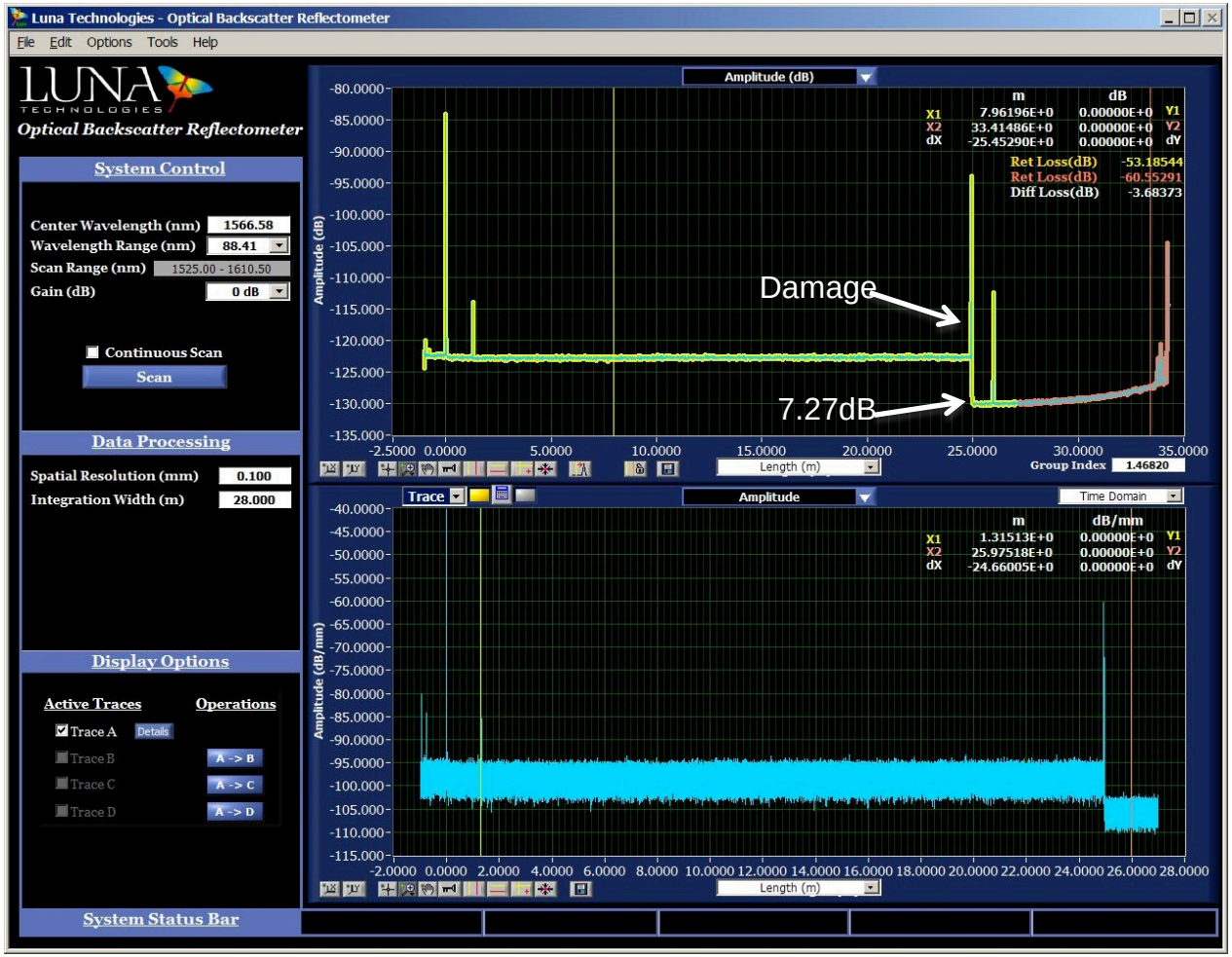
Damaged at 1 meter break out



24.6 m Another Breakout & Strain Relief Issue

(6-7 RED)

Damaged at 1 meter break out



Equipment Used for Study

- Source : Thorlabs, S1FC1550, 1 W, 1550nm
- Power Meter : Newport, 1916-R
  - w/ Detector Head : Newport, 818-IR
- Back Reflection Meter : OZ Optics, BM-100-3A-1550-9.125-S
- Interferometer : PROMET International, FiBO 250
- Polish Machine : Domaille Engineering, APM-HDL-5100
- Machine Polish disc :
  - 12 port ST,
  - 12 port FC,
  - 12 port LC,
  - 12 port FC/APC,
  - 12 port LC/APC
- Manual Polish disc: FIS :
  - Universal 2.5mm,
  - Universal 1.25mm,
  - FC/APC,
  - LC/APC
- Note : At the time of these test no MT polish was being done in house, so the only MT measurements are on those provided by MOLEX. Machine polished, but we do not know their equipment used.
- Polish Film : 12μm Diamond, 3μm Diamond, 0.1μm Alumina Oxide Final
- LUNA 4400